IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicants:	Lopatin, *et al.*
Title:	METHOD OF USING TERNARY COPPER ALLOY TO OBTAIN A LOW RESISTANCE AND LARGE GRAIN SIZE INTERCONNECT
Appl. No.:	09/994,395
Filing Date:	11/26/2001
Examiner:	Ori Nadav
Art Unit:	2811
Confirmation Number:	7882

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
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Dear Examiner Nadav:

Under the provisions of 37 C.F.R. § 41.37, this Appeal Brief is being filed in response to the Final Office Action dated July 12, 2007, and the Advisory Action dated August 10, 2007. Payment of $510.00 covering the 37 C.F.R. § 41.20(b)(2) appeal fee is included. If this is deemed to be insufficient, authorization is hereby given to charge any deficiency (or credit any balance) to the undersigned deposit account 19-0741.

1. REAL PARTY IN INTEREST

The real party in interest is the assignee of record, Advanced Micro Devices, Inc. (as recorded in the records of the United States Patent and Trademark Office at Reel/Frame 012331/0426 on November 26, 2001).

2. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences that will directly affect, be directly affected by, or have a bearing on the present appeal, that are known to Appellants or Appellants' patent representative.

3. STATUS OF CLAIMS

The present appeal is directed to Claims 1-4, 6, 8-13, 15-20, 22, and 23, all of which stand rejected pursuant to a final Office Action dated July 12, 2007.

4. STATUS OF AMENDMENTS

Claims 1-4, 6, 8-13, 15-20, 22, and 23 were pending in the application when a final Office Action dated July 12, 2007, was issued. An Advisory Action was issued on August 10, 2007. A Notice of Appeal was filed October 10, 2007.

5. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates generally to the fabrication of integrated circuits. See present application, page 1, paragraph [0002] and Figure 4. An exemplary embodiment includes a method forming a barrier layer along lateral side walls and a bottom of a via aperture and providing a ternary copper alloy via material in the via aperture to form a via. (See Para [0014].) The ternary copper alloy via material includes at least one element for increasing the grain size. (See Para [0032].)

Independent claim 1 relates to a method of fabricating an integrated circuit. The method includes depositing an etch stop layer (*e.g.*, etch stop layer 474, FIG. 4) over a first conductive

layer (*e.g.*, conductive layer 430, FIG. 4), where the etch stop layer is in direct contact with the first conductive layer. The method further includes depositing an insulating layer (*e.g.*, dielectric layer 442, FIG. 4) after the etch stop layer is deposited over the etch stop layer, forming a barrier layer (*e.g.*, barrier layer 440, FIG. 4) extending along lateral side walls and a bottom of a via aperture (*e.g.*, via section 420, FIG. 4), and depositing a copper alloy via material in the via aperture to form a via. The via aperture is configured to receive a via material that electrically connects a first conductive layer and a second conductive layer. The copper alloy material includes zinc (Zn) or silver (Ag) and at least one element increasing grain size including calcium (Ca) or chromium (Cr). (See Para. [0032]-[0033].)

Independent claim 10 relates to a method of using ternary copper alloy to obtain a low resistance and large grain size interconnect or via. The method includes providing a first conductive layer (*e.g.*, conductive layer 430, FIG. 4) or an integrated circuit substrate, providing an etch stop layer (*e.g.*, etch stop layer 474, FIG. 4) over the first conductive layer where the etch stop layer is in direct contact with the first conductive layer providing an insulating layer (*e.g.*, dielectric layer 442, FIG. 4). After the etch stop layer has been provided over the first conductive layer, providing a conformal layer section (*e.g.*, barrier layer 440, FIG. 4) extending along a bottom and sides of a via aperture (*e.g.*, via section 420, FIG. 4), positioned over the first conductive layer to form a barrier separating the via aperture from the first conductive layer, filling the via aperture with a ternary copper alloy via material to form a ternary copper alloy via, and providing a second conductive layer (*e.g.*, conductive via layer 410, FIG. 4) over the ternary copper alloy via such that the ternary copper alloy via electrically connects the first conductive layer to the second conductive layer. The ternary copper alloy includes at least one element for increasing grain size and at least one of chromium (Cr) or calcium (Ca) where the ternary copper alloy material includes an element with a characteristic for increasing grain size of the ternary copper alloy via. (See Para. [0032].)

Independent claim 17 relates to a method of forming a via in an integrated circuit. The method includes depositing a first conductive layer (*e.g.*, conductive layer 630, FIG. 6),

depositing an etch stop layer (*e.g.*, etch stop layer 674, FIG. 6) over the first conductive layer, where the etch stop layer is in direct contact with the first conductive layer, depositing an insulating layer (*e.g.*, dielectric layer 642, FIG. 6) over the etch stop layer, forming an aperture in the insulating layer and the etch stop layer, providing a barrier material extending along a bottom and sides of the aperture to form a barrier layer (*e.g.*, barrier layer 640, FIG. 6), filling the aperture with a ternary copper alloy via material to form a ternary copper alloy via, (*e.g.*, via/trench Section 620, FIG. 6), and providing a second conductive layer (*e.g.*, conductive layer 610, FIG. 6) over the ternary copper alloy via such that the ternary copper alloy via electric connects the first conductive layer and the second conductive layer. (See Para. [0042].) The ternary copper alloy via includes at least one of the following pairs of elements, Tin and Calcium, Tin and Chromium, Zinc and Chromium, Zinc and Calcium, Silver and Chromium, and Silver and Calcium. The ternary copper alloy via material includes an element with a characteristic for increasing grain size of ternary copper alloy via.

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of rejection that Appellants request the Board review are provided below. Appellants respectfully submit that the Examiner erred in rejecting:

1. Claims 1-3, 6, 10, 15, 17-20 and 22 as being anticipated under 35 U.S.C. § 102(e) over U.S. Patent No. 6,399,496 (Edelstein *et al.*) and U.S. Patent 6,749,689 (Bögel *et al.*).

2. Claims 8, 13 and 16 as being unpatentable under 35 U.S.C. § 103(a) over Edelstein *et al.* in view of Bögel *et al.*

3. Claim 4 as being unpatentable under 35 U.S.C. § 103(a) over Edelstein *et al.* in view of Bögel *et al.* and further in view of U.S. Patent No. 6,440,849 (Merchant *et al.*).

4. Claims 9 and 23 as being unpatentable under 35 U.S.C. § 103(a) over Edelstein *et al.* and Bögel *et al.* and further in view of U.S. Patent No. 6,380,083 (Gross).

5. Claims 11-12 as being unpatentable under 35 U.S.C. § 103(a) over Edelstein *et al.* in view of Bögel *et al.*, and further in view of U.S. Patent No. 6,090,710 (Andricacos *et al.*).

7. ARGUMENT

A. LEGAL STANDARDS

1. Standard Under 35 U.S.C. § 102(e)

A prior art reference, as defined by 35 U.S.C. § 102, is said to "anticipate" a claimed invention if each and every element of the claimed invention is disclosed, either expressly or inherently, in the prior art reference. *In re* Spada, 911 F.2d 705, 708, 15 U.S.P.Q.2d 1655, 1657 (Fed. Cir. 1990). In deciding the issue of anticipation, one must identify the elements of the claims, determine their meaning in light of the specification and prosecution history, and identify corresponding elements disclosed in the allegedly anticipating reference. Lindemann Maschinenfabrik v. American Hoist & Derrick Co., 730 F.2d 1452, 1458, 221 U.S.P.Q. 481, 485-86 (Fed. Cir. 1984).

The Federal Circuit explained the requirements for anticipation in Kalman v. Kimberly-Clark Corp., 713 F.2d 760, 218 U.S.P.Q. 781 (Fed. Cir. 1983), by stating:

> The law of anticipation does not require that the reference "teach" what the subject patent teaches. Assuming that a reference is properly "prior art," it is only necessary that the claims under attack, as construed by the court, "read on" something disclosed in the reference, *i.e.*, all limitations of the claim are found in the reference, or "fully met" by it.

Id. at 772, 218 U.S.P.Q. at 789.

Extrinsic evidence from those skilled in the art can be used to explain, but not to expand the meaning of a disclosed element in that single prior art reference, to determine whether the reference anticipates the claims at issue. *In re* Baxter Travenol Labs, 952 F.2d 388, 21 U.S.P.Q.2d 1281 (Fed. Cir. 1991).

2. Standard Under 35 U.S.C. § 103(a)

Claims 4, 8, 9, 11-13, 16 and 23 have been rejected under 35 U.S.C. § 103(a), which states:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The legal standards under 35 U.S.C. § 103(a) are well-settled. Obviousness under 35 U.S.C. § 103(a) involves four factual inquiries: 1) the scope and content of the prior art; 2) the differences between the claims and the prior art; 3) the level of ordinary skill in the pertinent art; and 4) secondary considerations, if any, of nonobviousness. See Graham v. John Deere Co., 383 U.S. 1, 148 U.S.P.Q. 459 (1966).

In proceedings before the Patent and Trademark Office, the Examiner bears the burden of establishing a prima facie case of obviousness based upon the prior art. *In re* Piasecki, 745 F.2d 1468, 1471-72, 223 U.S.P.Q. 785, 787-88 (Fed. Cir. 1984). "'[The Examiner] can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references.'" *In re* Fritch, 972 F.2d 1260, 1265, 23 U.S.P.Q.2d 1780, 1783 (Fed. Cir. 1992).

As noted by the Federal Circuit, the "factual inquiry whether to combine references must be thorough and searching." McGinley v. Franklin Sports, Inc., 262 F.3d 1339, 60 USPQ.2d 1001 (Fed. Cir. 2001). Further, it "must be based on objective evidence of record." *In re* Lee, 277 F.3d 1338, 61 USPQ.2d 1430 (Fed. Cir. 2002). The teaching or suggestion to make the claimed combination must be found in the prior art, and not in the applicant's disclosure. *In re* Vaeck, 947 F.2d 488, 20 USPQ.2d 1438 (Fed. Cir. 1991). The mere fact that references can be

combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re* Mills, 916 F.2d 680, 16 USPQ.2d 1430 (Fed. Cir. 1990). "It is improper, in determining whether a person of ordinary skill would have been led to this combination of references, simply to '[use] that which the inventor taught against its teacher.'" Lee (citing W.L. Gore v. Garlock, Inc., 721 F.2d 1540, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983)).

B. REJECTION OF CLAIMS 1-3, 6, 10, 15, 17-20 AND 22 UNDER 35 U.S.C. § 102(e) BASED ON EDELSTEIN *ET AL.* IN VIEW OF BÖGEL *ET AL.*

In the final Office Action dated July 12, 2007, Claims 1-3, 6, 10, 15, 17-20 and 22 were rejected under 35 U.S.C. § 102(e) over Edelstein *et al.* in view of Bögel *et al.* The Examiner maintained these rejections in the Advisory Action mailed August 10, 2007. Appellants respectfully request the Board reverse the rejection for at least the reasons that are described below.

1. The Examiner's rejection of Claims 1-3, 6, 10, 15, 17-20 and 22 under 35 U.S.C. § 102(e) over Edelstein *et al.* in view of Bögel *et al.* should be reversed because at least one limitation of each of these claims is not taught or suggested by the combination.

To anticipate a claimed invention, all the claim limitations must be taught or suggested by the prior art. The rejected claims are not anticipated because at least one limitation from independent claims 1, 10, and 17 is not taught or suggested by Edelstein *et al.* or Bögel *et al.*

For example, independent claim 1 requires:

> the copper alloy material including Zinc (Zn) or Silver (Ag) and at least one element for increasing grain size including Calcium (Ca) or Chromium (Cr).

Appellants have repeatedly pointed out that Edelstein *et al.* does not mention grain size ***at all***. Edelstein *et al.* describes the use of "seed layers." The section referred to by the Examiner in the Edelstein *et al.* – Col. 8, lines 35-52 – states that seed layers are used to "improve the

adhesion properties relative to pure copper." (Col. 8, lines 36-37.) Bögel *et al.* does not provide the missing teaching either. It describes change in grain growth due to *annealing time* and *temperature*, not by the addition of an element.

In the Final Office Action mailed June 26, 2006, the Examiner admits "***Edelstein et al.* and *Bögel et al.* do not explicitly state increasing the grain size due to chromium.**" (Page 6, emphasis added.) Yet the rejections based on Edelstein *et al.* and Bögel *et al.* are maintained because the Examiner alleges that "*increasing the grain size due to chromium*" is "*inherent in prior art's devices, because the addition of Calcium (Ca) or Chromium (Cr) increases grain size.*" Appellants' response to the Final Office Action of June 26, 2006, requested that the Examiner provide evidence to support the assertion of inherency, as required by M.P.E.P. 2112. The Examiner gave no such evidence or basis in fact. Rather, in the Advisory Action dated August 21, 2006, the Examiner states:

> The Examiner maintains the position that the addition of calcium (Ca) or chromium (Cr) increases grain size, because Applicant clearly states that the addition of calcium (Ca) or chromium (Cr) increases grain size. Note that the combination do not rely on hindsight because the combination is based on providing the device stable Cu alloy with improved electromigration properties.

(Advisory Action, page 3, emphasis added.)

The Examiner's comment does not seem to make logical sense. It appears that the Examiner is arguing that adding Calcium (Ca) or Chromium (Cr) increases grain size because the Appellants say so! The Examiner's comments in the Advisory Action of August 21, 2006, are not responsive and provide no support for the underlying rational for the rejection. Moreover, the Examiner is using improper "hindsight" using Appellants' teachings for the rejection. The Examiner suggests that he is not using hindsight because "*the combination is based on providing the device stable Cu alloy with improved electromigration properties.*" Nevertheless, whether or not the combination of the references provides improved electromigration properties has nothing to do with using an element, such as Ca or Cr, to increase grain size!

After the first appeal, the Examiner re-opened prosecution. In the non-final Office Action mailed July 23, 2007, the Examiner changed the § 103 rejection based on Soininen *et al.*, Edelstein *et al.*, and Bögel *et al.* to a § 102 rejection based on Edelstein *et al.* "as supported by" Bögel *et al.* (page 3, Office Action). The Examiner posited that even though Edelstein *et al.* does not state increasing grain size, it is known that Calcium (Ca) or Chromium (Cr) do so (pages 3-4, Office Action dated July 23, 2007). This argument is the same as that made in the Final Office Action dated June 26, 2006, mentioned above. Like before, Appellant urged the Examiner to meet the burden of proof required to show inherency. The Examiner has only made the conclusory statement: "it is known in the art that the inclusion of Calcium and Chromium (Cr) increases grain size." The Examiner has not provided "a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art," as required by MPEP 2112, quoted above.

Edelstein *et al.* does not describe grain size, increasing grain size, an element increasing grain size, or improving electromigration. MPEP 2131.01 states that an extra reference or evidence can be used to show an "inherent characteristic of the thing taught by the primary reference." However, in this situation, Edelstein *et al.* does not teach the "thing" at all, which is improving electromigration by increasing grain size.

Bögel *et al.* does not provide the teachings or support missing from Edelstein *et al.* The Examiner states that "Bögel *et al.* is merely cited as supporting evidence that the inclusion of Calcium (Ca) or Chromium (Cr) increases the grain size." However, Bögel *et al.* fails as "supporting evidence." First, Bögel *et al.* does not "support any other evidence because the Examiner has not given any evidence except the Examiner's own conclusion that Calcium (Ca) or Chromium (Cr) increases the grain size. Second, Bögel *et al.* is in a completely different technology. Bögel *et al.* specifically states that its invention is directed to "under the hood **automotive** applications" (Col. 4, lines 60-61, emphasis added). In the "Description of Related Art," Bögel *et al.* lists "leadframes, wires, tubes" and other items as products including copper alloys. (See Col. 1, lines 24-25.) Edelstein *et al.* relates to the "technology of making

interconnections to provide for vias, lines, and other recesses in semiconductor chip structures" (Background of the Invention, col. 1, lines 20-22.) Third, Bögel *et al.* does not even support the proposition that Chromium (Cr) increases the grain size. The Examiner cites to col. 7, lines 65-67 of Bögel *et al.*, which states:

> FIG. 3 graphically illustrates the effect of solution annealing (SA) time and temperature on the recrystallization and grain growth for a copper alloy having 0.40% chromium.

This language in Bögel *et al.* describes change in grain growth due to *annealing time* and *temperature*, not by the addition of an element. There is no causation taught or suggested that including Calcium (Ca) or Chromium (Cr) increases grain size. It is simply wrong to say that Bögel *et al.* is evidence "that the inclusion of Calcium (Ca) or Chromium (Cr) increases the grain size," as the Examiner suggests.

As the Examiner has admitted, none of the cited references teach or suggest:

> "depositing a copper alloy material…including…at least one element for increasing grain size including Calcium (Ca) or Chromium (Cr),"

required by claim 1, or

> "the ternary copper alloy via material includes an element with a characteristic for increasing grain size of the ternary copper alloy via,"

required by independent claims 10 and 17. Moreover, there is no evidence to support the Examiner's new position that these teachings are "inherent."

The rejection of claims 1-3, 6, 10, 15, 17-20 and 22 under 35 U.S.C § 102(e) should be withdrawn. Edelstein *et al.* or Bögel *et al.* proffered by the Examiner fails to suggest or teach at least one limitation of each of these rejected claims. As such, the Board should find that the Examiner has not established a *prima facie* case of anticipation and reverse the rejection.

C. REJECTION OF CLAIMS 4, 8-9, 12-13, 16 AND 23 UNDER 35 U.S.C. § 103(a) BASED ON EDELSTEIN *ET AL.*, BÖGEL *ET AL.* AND OTHERS

2. The Examiner's rejection of claims 4, 8-9, 12-13, 16 and 23 should be reversed because there is no suggestion or motivation to combine the teachings of the references cited by the Examiner.

To establish a *prima facie* case of obviousness based on a combination of prior art references under 35 U.S.C. § 103(a), the Examiner must first show that there is a suggestion or motivation to combine the teachings of those references. This may come in the form of some objective teaching in the prior art or, alternatively, knowledge generally available to one of ordinary skill in the art at the time of the invention that would lead that individual to combine the relevant teachings of the references. When the motivation to combine the teachings of the references is not immediately apparent, it is the duty of the Examiner to explain why the combination of the teachings is proper. Ex parte Skinner, 2 U.S.P.Q.2d 1788 (Bd. Pat. App. & Inter. 1986).

In the present case, the rejections are based, at least in part, on the combination of Edelstein *et al.* and Bögel *et al.* The Examiner refers to Bögel *et al.* because, according to the Examiner, Edelstein *et al.* does not teach increasing grain size using Calcium (Ca) or Chromium (Cr). As discussed above, Appellants contend that Bögel *et al.* does not provide this teaching. Assuming *arguendo* that it does, a person of skill in the art would not look to Bögel *et al.* for the teachings missing in Edelstein *et al.* Bögel *et al.* specifically states that its invention is directed to "under the hood **automotive** applications" (Col. 4, lines 60-61). There is no suggestion that such a reference would be combined with Edelstein *et al.*, which relates to the "formation of interconnection structures in integrated circuits" (Abstract). Bögel *et al.* is not within the Appellants' field of endeavor and, further, Bögel *et al.* does not relate to a particular problem addressed by Appellants' claimed invention, namely increasing electromigration properties by increasing the grain size in a via material. (See M.P.E.P. 2141.01(a).)

The Board should find that there is no suggestion or motivation to combine Bögel *et al.* with Edelstein *et al.*, as the Examiner did in rejecting claims 4, 8-9, 12-13, 16 and 23.

D. REJECTION OF CLAIM 4 UNDER 35 U.S.C. § 103(a)

The Examiner's rejection of claim 4 should be reversed because at least one limitation is not taught or suggested by the combination offered by the Examiner. Claim 4 depends from independent claim 1 and, as such, includes all of the limitations of claim 1. As explained above with respect to independent claim 1, the combination of Edelstein *et al.* and Bögel *et al.* fails to suggest or teach "depositing a copper alloy material…including…at least one element for increasing grain size including Calcium (Ca) or Chromium (Cr)," required by claim 1. In rejecting claim 4, Examiner points to Merchant *et al.*, but Merchant *et al.* does not suggest or teach increasing grain size using Calcium (Ca) or Chromium (Cr).

In addition to the combination not teaching all of the limitations of the claims, as explained above, there is no suggestion or motivation to combine the automotive applications described by Bögel *et al.* with the integrated circuit manufacturing processes described by Edelstein *et al.* The Board should reverse the rejection of claim 4.

E. REJECTION OF CLAIMS 9 AND 23 UNDER 35 U.S.C. § 103(a)

The Examiner's rejection of claims 9 and 23 should be reversed because at least one limitation is not taught or suggested by the combination offered by the Examiner. Claim 9 depends from independent claim 1 and, as such, includes all of the limitations of claim 1. As explained above with respect to independent claim 1, the combination of Edelstein *et al.* and Bögel *et al.* fails to suggest or teach "depositing a copper alloy material…including…at least one element for increasing grain size including Calcium (Ca) or Chromium (Cr)," required by claim 1. In rejecting claim 9, the Examiner points to Gross, but Gross also does not suggest or teach increasing grain size using Calcium (Ca) or Chromium (Cr).

Claim 23 depends from independent claim 17 and, as such, includes all of the limitations of claim 17. As explained above, the combination of Edelstein *et al.* and Bögel *et al.* fails to suggest or teach "the ternary copper alloy via material includes an element with a characteristic

for increasing grain size of the ternary copper alloy via," required by independent claim 17. In the rejection of claim 23, Examiner points to Gross, but Gross does not suggest or teach an element with a characteristic for increasing grain size of the ternary copper alloy via.

In addition to the combination not teaching all of the limitations of the claims, as explained above, there is no suggestion or motivation to combine the automotive applications described by Bögel *et al.* with the integrated circuit manufacturing processes described by Soininen *et al.* The Board should reverse the rejection of claims 9 and 23.

F. REJECTION OF CLAIMS 11-12 UNDER 35 U.S.C. § 103(a)

The Examiner's rejection of claims 11 and 12 should be reversed because at least one limitation is not taught or suggested by the combination offered by the Examiner. Claims 11 and 12 depend from independent claim 10 and, as such, include all of the limitations of claim 10. As explained above, the combination of Edelstein *et al.* and Bögel *et al.* fails to suggest or teach "the ternary copper alloy via material includes an element with a characteristic for increasing grain size of the ternary copper alloy via," required by independent claim 10. In rejecting claims 11-12, the Examiner points to Andricacos *et al.*, but Andricacos *et al.* does not provide this missing teaching.

In addition to the combination not teaching all of the limitations of the claims, as explained above, there is no suggestion or motivation to combine the automotive applications described by Bögel *et al.* with the integrated circuit manufacturing processes described by Edelstein *et al.* The Board should reverse the rejection of claims 11 and 12.

8. CONCLUSION

In view of the foregoing, Appellants submit that claims 1-3, 6, 10, 15, 17-20 and 22 are not properly rejected under 35 U.S.C. § 102(e) and are, therefore, patentable. Further, claims 4, 8, 9, 11-13, 16 and 23 are not properly rejected under 35 U.S.C. § 103(a) and are, therefore, patentable. The first rejection (claims 1-3, 6, 10, 15, 17-20 and 22 based on Edelstein *et al.* or

Bögel *et al.*) cannot be properly maintained because the references do not suggest or teach all of the claim limitations. The second rejection (claims 8, 13 and 16 based on Edelstein *et al.* and Bögel *et al.*) does not suggest or teach all of the claim limitations and there is no suggestion or motivation to combine the references. The third rejection (claim 4 based on Edelstein *et al.*, Bögel *et al.*, and Merchant *et al.*) does not suggest or teach all of the claim limitations and there is no suggestion or motivation to combine the references as done by the Examiner. The fourth rejection (claims 9 and 23 based on Edelstein *et al.*, Bögel et al and Gross) does not suggest or teach all of the claim limitations and there is no suggestion or motivation to combine the references as done by the Examiner. The fifth rejection (claims 11-12) based on Edelstein *et al.*, Bögel et al and Andricacos *et al.*) does not suggest or teach all of the claim limitations and there is no suggestion or motivation to combine the references as done by the Examiner. Accordingly, the Appellants respectfully request that the Board reverse all claim rejections and indicate that a notice of allowance respecting all pending claims should be issued.

Respectfully submitted,

Date November 21, 2007

By ______________________

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CLAIMS APPENDIX

1. (Previously Presented) A method of fabricating an integrated circuit, the method comprising:

depositing an etch stop layer over a first conductive layer, wherein the etch stop layer is in direct contact with the first conductive layer;

depositing an insulating layer after the etch stop layer is deposited over the etch stop layer;

forming a barrier layer extending along lateral side walls and a bottom of a via aperture, the via aperture being configured to receive a via material that electrically connects the first conductive layer and a second conductive layer; and

depositing a copper alloy via material in the via aperture to form a via, the copper alloy material including Zinc (Zn) or Silver (Ag) and at least one element for increasing grain size including Calcium (Ca) or Chromium (Cr).

2. (Previously Presented) The method of claim 1, wherein the copper alloy via material includes silver (Ag).

3. (Previously Presented) The method of claim 2, wherein the copper alloy via material includes Zinc (Zn).

4. (Previously Presented) The method of claim 1, wherein the copper alloy via material includes one atomic percent or less of Zinc (Zn) or Silver (Ag).

5. (Cancelled)

6. (Previously Presented) The method of claim 1, wherein the copper alloy via material includes Chromium (Cr).

7. (Cancelled)

8. (Previously Presented) The method of claim 6, wherein the element with a characteristic for increasing grain size is one atomic percent or less of Chromium (Cr).

9. (Original) The method of claim 6, wherein the increased grain size is between 0.5 and 3 μm.

10. (Previously Presented) A method of using ternary copper alloy to obtain a low resistance and large grain size interconnect or via, the method comprising:

providing a first conductive layer over an integrated circuit substrate;

providing an etch stop layer over the first conductive layer, wherein the etch stop layer is in direct contact with the first conductive layer;

providing an insulating layer over the etch stop layer after the etch stop layer has been provided over the first conductive layer;

providing a conformal layer section extending along a bottom and sides of a via aperture positioned over the first conductive layer to form a barrier separating the via aperture from the first conductive layer;

filling the via aperture with a ternary copper alloy via material to form a ternary copper alloy via, the ternary copper alloy including at least one element for lowering resistivity and at least one of Chromium (Cr) or Calcium (Ca), wherein the ternary copper alloy via material includes an element with a characteristic for increasing grain size of the ternary copper alloy via; and

providing a second conductive layer over the ternary copper alloy via such that the ternary copper alloy via electrically connects the first conductive layer to the second conductive layer.

11. (Previously Presented) The method of claim 10, wherein the ternary copper alloy via material is at least 98 atomic percent copper.

12. (Previously Presented) The method of claim 11, wherein the ternary copper alloy via includes Zinc (Zn), Silver (Ag), or Tin (Sn).

13. (Previously Presented) The method of claim 11, wherein the ternary copper alloy via includes one atomic percent or less of Chromium (Cr) or Calcium (Ca).

14. (Cancelled)

15. (Previously Presented) The method of claim 10, wherein the element with a characteristic for increasing grain size is Calcium (Ca) or Chromium (Cr).

16. (Previously Presented) The method of claim 10, wherein the element with a characteristic for increasing grain size is one atomic percent or less of the ternary copper alloy via material.

17. (Previously Presented) A method of forming a via in an integrated circuit, the method comprising:

depositing a first conductive layer;

depositing an etch stop layer over the first conductive layer, wherein the etch stop layer is in direct contact with the first conductive layer;

depositing an insulating layer over the etch stop layer;

forming an aperture in the insulating layer and the etch stop layer;

providing a barrier material extending along a bottom and sides of the aperture to form a barrier layer;

filling the aperture with a ternary copper alloy via material to form a ternary copper alloy via including at least one of the following pairs of elements: Tin and Calcium; Tin and Chromium; Zinc and Chromium; Zinc and Calcium; Silver and Chromium; and Silver and Calcium, wherein the ternary copper alloy via material includes an element with a characteristic for increasing grain size of the ternary copper alloy via; and

providing a second conductive layer over the ternary copper alloy via such that the ternary copper alloy via electrically connects the first conductive layer and the second conductive layer.

18. (Previously Presented) The method of claim 17, wherein the ternary copper alloy via material includes copper (Cu), tin (Sn), and Calcium (Ca).

19. (Original) The method of claim 17, wherein the ternary copper alloy via material includes copper (Cu), zinc (Zn), and chromium (Cr).

20. (Previously Presented) The method of claim 17, wherein the ternary copper alloy is CuAgCr, or CuSnCa.

21. (Cancelled)

22. (Previously Presented) The method of claim 17, wherein the ternary copper alloy via includes stuffed grain boundaries.

23. (Original) The method of claim 17, wherein the grain size of the ternary copper alloy via is 0.5 to 3 μm.

EVIDENCE APPENDIX

No evidence entered with this Brief.

RELATED PROCEEDINGS APPENDIX

There are no related appeals and interferences.